Remarks

Claims 12-25 are pending in the application and subject to rejection. Reconsideration is requested in view of the following remarks.

Response to Section 102 Rejection of Claims 12-20, 22, 24 and 25 over Brennecke *et al.* as evidenced by Erickson and Sweeney *et al.*

Claims 12-20, 22 and 24-25 have been rejected as allegedly anticipated by Brennecke *et al.* as evidenced by Erickson and Sweeney *et al.* The rejection alleges that Brennecke *et al.* discloses purification of gas with liquid ionic compounds.

Brennecke *et al.* teaches the use of well defined "liquid ionic compounds" (LIC) or ionic liquids for purifying gases by means of a method wherein impurities contained in the gases absorb into the ionic liquid. While Col. 3, line 49-50 mentions a general applicability of the method for oxygen removing purposes, further passages pertaining to oxygen absorption, *i.e.*, Examples 2, 3, and 6, clearly show that the ionic liquids used by Brennecke *et al.* are not suitable for selectively absorbing oxygen from gaseous mixtures, as the solubility of oxygen therein is very low, *i.e.*, the oxygen concentration is almost undetectable (cf. Table II in Col. 13).

Those skilled in the art will easily recognize that this is due to the nature of the cations of the ionic liquids used by Brennecke *et al.*, which are able to absorb dipolar compounds such as CO_2 or H_2O, but not the O_2 molecule. The ionic liquids used by Brennecke *et al.* therefore do not show a selective oxygen-uptake capacity, as required according to the instant claims ("said method comprising *selectively* absorbing oxygen from a gaseous mixture"). Rather the ionic liquids of Brennecke *et al.* are hardly capable of solvating oxygen at all. The teachings of Brennecke *et al.* actually lead away from the method of the present invention.

Erickson is cited as evidence that it would be allegedly obvious to use concentrated, pressurize oxygen as a reaction partner for combustion or oxidation reactions. Erickson does not cure the deficiencies in Brennecke *et al.* Moreover, as already stated in the reply to the last Office Action, Erickson uses a molten alkali metal salt, preferably an alkali metal nitrite or nitrate (having melting points of at least 264 °C) for separating oxygen from air by chemical

redox reactions between oxygen and the nitrite/nitrate ions. Thus, Erickson does not disclose the use of an ionic liquid according to the acknowledged definition of an "ionic liquid". *See, e.g.*, the *Wikipedia* definition of "ionic liquid" provided in response to the last Office Action (ionic liquids have melting points <100 °C), or the definition provided in the present application at page 4 (ionic liquids have(melting points <80 °C). Nor does Erickson disclose the separation of oxygen from air or another gaseous mixture by absorbing oxygen into the ionic liquid, *i.e.*, by physisorption processes rather than by chemical reaction (chemisorption).

The fact that oxygen can be used in the manufacture of steel or in future coal conversion and hydrogen generation processes, as incidentally mentioned by Erickson in the introductory section, cannot be regarded as an anticipation of the present invention's purpose of providing the oxygen absorbed into the ionic liquid as a reaction partner for combustion and oxidation reactions, as detailed in the present application. According to the present invention, oxygen absorbed into an ionic liquid is made available for combustion reactions by blowing it out of the ionic liquid medium using the exhaust gases of the combustion process, or by means of microwaves, catalytic processes, or temperature/pressure changes.

Claim 12 is not anticipated by Brennecke *et al.* as evidenced by Erickson. It is respectfully submitted that claim 12 is allowable.

Sweeney is cited as evidence, allegedly relevant to claim 19, that contacting LIC with gaseous mixtures may be accomplished by a trickle bed. Sweeney does not cure the deficiencies in Brennecke *et al.* Sweeney discloses a "three phase mixing process for carrying out heterogeneous vapor phase reactions" between two gaseous reactants within a liquid having catalyst particles dissolved therein, wherein one of the gaseous reactants may be oxygen (and the other a hydrocarbon, for example). No mention is made of ionic liquids nor of oxygen separation processes. Thus, Sweeney does not "evidence" the use of a trickle bed for absorbing oxygen from a gaseous mixture by contacting the gaseous mixture and an ionic liquid medium in a trickle-bed contactor.

Claims 13-20, 22 and 24-25 depend directly or indirectly from claim 12, and recite additional features of the method of claimed 12. In view of the allowability of claim 12,

claims 13-20, 22 and 24-25 are similarly allowable over Brennecke *et al.* as evidenced by Erickson and Sweeney *et al.*

Response to Section 103 Rejection of Claim 21 over Brennecke *et al.* in view of Ramprasad *et al.* and Voorhees

Claim 21 has been rejected as allegedly unpatentable under 35 U.S.C. 103 over Brennecke *et al.*, in view of Ramprasad *et al.* and Voorhees. Claim 21 defines a method according to claim 12, wherein the absorbed oxygen is released from the liquid medium by passing combustion exhaust gases through that medium.

Claim 21 depends from claim 12, and recites additional features of the method of claimed 12. The deficiencies of Brennecke *et al.*, discussed above in connection with the rejection of claim 12, are not remedied by Ramprasad *et al.* and Voorhees. Accordingly, claim 21 is not rendered obvious by the combination of Brennecke *et al.*, Ramprasad *et al.* and Voorhees.

Response to Section 103 Rejection of Claim 23 over Brennecke *et al.* in view of Horn *et al.*

Claim 23 has been rejected as allegedly unpatentable under 35 U.S.C. 103 over Brennecke *et al.*, further in view of Horn *et al.*

Claim 23 depends from claim 12, and recites the additional feature whereby absorbed oxygen is released from the liquid medium by catalytically degassing the liquid medium. The deficiencies of Brennecke *et al.*, discussed above, are not remedied by Horn *et al.* Accordingly, claim 23 is not rendered obvious by the combination of Brennecke *et al.* and Horn *et al.*

Response to Section 103 Rejection of Claims 12-20, 22 and 24-25 over Cassano in view of Brennecke *et al.*, as evidenced by Erickson

Claims 12-20, 22 and 24-25 has been rejected as allegedly unpatentable under 35 U.S.C. 103 over Cassano in view of Brennecke *et al.*, as evidenced by Erickson.

The rejection alleges that Cassano teaches the use of a molten alkali metal salt,

preferably an alkali metal nitrite or nitrate, for separating oxygen from air. The rejection admits that Cassano does not teach the use of an ionic liquid as in the process as claimed. The rejection alleges, however, that it would have been obvious to replace the molten salt of Cassano with an ionic liquid of Brennecke *et al.* Erickson is asserted as evidence with respect to the rejection of claim 16.

Both Cassano and Erickson teach the use of molten alkali metal nitrites and nitrates for chemisorbing oxygen into a melt having a temperature of at least 264°C. No mention is made in Cassano or Erickson of ionic liquids for reversibly physisorbing oxygen into such liquid. While Brennecke *et al.* generally mentions the possibility of using ionic liquids for separating oxygen from other gaseous components, he does not teach any specific ionic liquid suitable for this purpose. On the contrary, as mentioned above, Brennecke *et al.* explicitly discloses ionic liquids showing very poor oxygen-uptake capacities, so that the Brennecke *et al.* actually teachings away from the present invention.

In view of the adverse teachings of Brennecke *et al.* regarding the use of ionic liquids to selectively absorb oxygen form gaseous mixtures, the skilled artisan would not be motivated to substitute an ionic liquid for the molten alkali metal salts of Cassano. Thus, the method of claim 12 would not have been obvious to one of ordinary skill in the art from Cassano in view of Brennecke *et al.*, as evidenced by Erickson.

Claims 13-20, 22 and 24-25 depend directly or indirectly from claim 12, and recite additional features of the method of claimed 12. In view of the allowability of claim 12, claims 14, 16, 22 and 24-25 are similarly allowable over Cassano in view of Brennecke *et al.*, as evidenced by Erickson.

Response to Section 103 Rejection of Claim 21 over Cassano *et al.* in view of Brennecke *et al.*, further in view of Ramprasad *et al.* and Voorhees

Claim 21 has been rejected as allegedly unpatentable under 35 U.S.C. 103 over Cassano *et al.* in view of Brennecke *et al.*, further in view of Ramprasad *et al.* and Voorhees.

Claim 21 defines a method according to claim 12, wherein the absorbed oxygen is released from the liquid medium by passing combustion exhaust gases through that medium.

Claim 21 depends from claim 12, and recites additional features of the method of claimed 12. The deficiencies of Cassano and Brennecke *et al.*, discussed above in connection with the rejection of claim 12, are not remedied by Ramprasad *et al.* and Voorhees. Neither Ramprasad *et al.* nor Voorhees teach the use of ionic liquids to selectively absorb oxygen form gaseous mixtures. Accordingly, claim 21 is not rendered obvious by the combination of Brennecke *et al.*, Cassano *et al.* in view of Brennecke *et al.*, further in view of Ramprasad *et al.* and Voorhees.

Response to Section 103 Rejection of Claim 23 over
Cassano in view of Ramprasad *et al.* and Horn *et al.*

Claim 23 has been rejected as allegedly unpatentable under 35 U.S.C. 103 over Cassano, in view of Brennecke *et al.*, further in view of Horn *et al.*

Claim 23 depends from claim 12, and recites additional features of the method of claimed 12. The deficiencies of Cassano and Brennecke *et al.*, discussed above, are not remedied by Horn *et al.* Horn *et al.* does not teach the use of ionic liquids to selectively absorb oxygen form gaseous mixtures

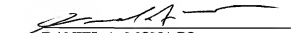
Accordingly, claim 23 is not rendered obvious by the combination of Cassano, Brennecke *et al.* and Horn *et al.*

Conclusion

The claims remaining in the application are believed to be in condition for allowance. An early action toward that end is earnestly solicited.

Respectfully submitted,

RUDOLF GHECZY, *et al.*



DANIEL A. MONACO
Registration No. 30,480
DRINKER BIDDLE & REATH LLP
One Logan Square, Suite 2000
Philadelphia, PA 19103-6996
(215) 988-3312 - Phone
(215) 988-2757 - Fax
Attorney for the Applicants